Battery tests safety review

Date: 11/10/03

Ioannis Marneris

Purpose: To evaluate the repeatability of the battery discharge current for 1000 to 5000 pulses, using the following resistive loads. The pulse current will vary from 700 amps to 1050 to 1400 amps. The pulse width will vary from 300 msec to 30 sec.

Battery: INTERSTATE BATTERIES type 8D-MHD 12V, BCI# 8D, 1400 CCA(30 seconds, 7.2V minimum), RC 450 minutes (@25A, 10.5V minimum). Engine cranking battery.

Load: Hubbell stainless steel resistors. Assembled from RHIC energy dump resistor bank elements. 406 stainless steel, temperature coefficient of resistance= 0.00091/F (average @68/800 F).
4.87 mohms, @1400A, 30s, 9.545KW, 286KJ
8.4 mohms, @1050A, 30s, 9.261KW, 278KJ
14.4 mohms, @700A, 30s, 7.056KW, 212KJ

Electrical-mechanical contactor: SIEMENS 14-193-221-57-2, 1600A, single pole, 1500V.

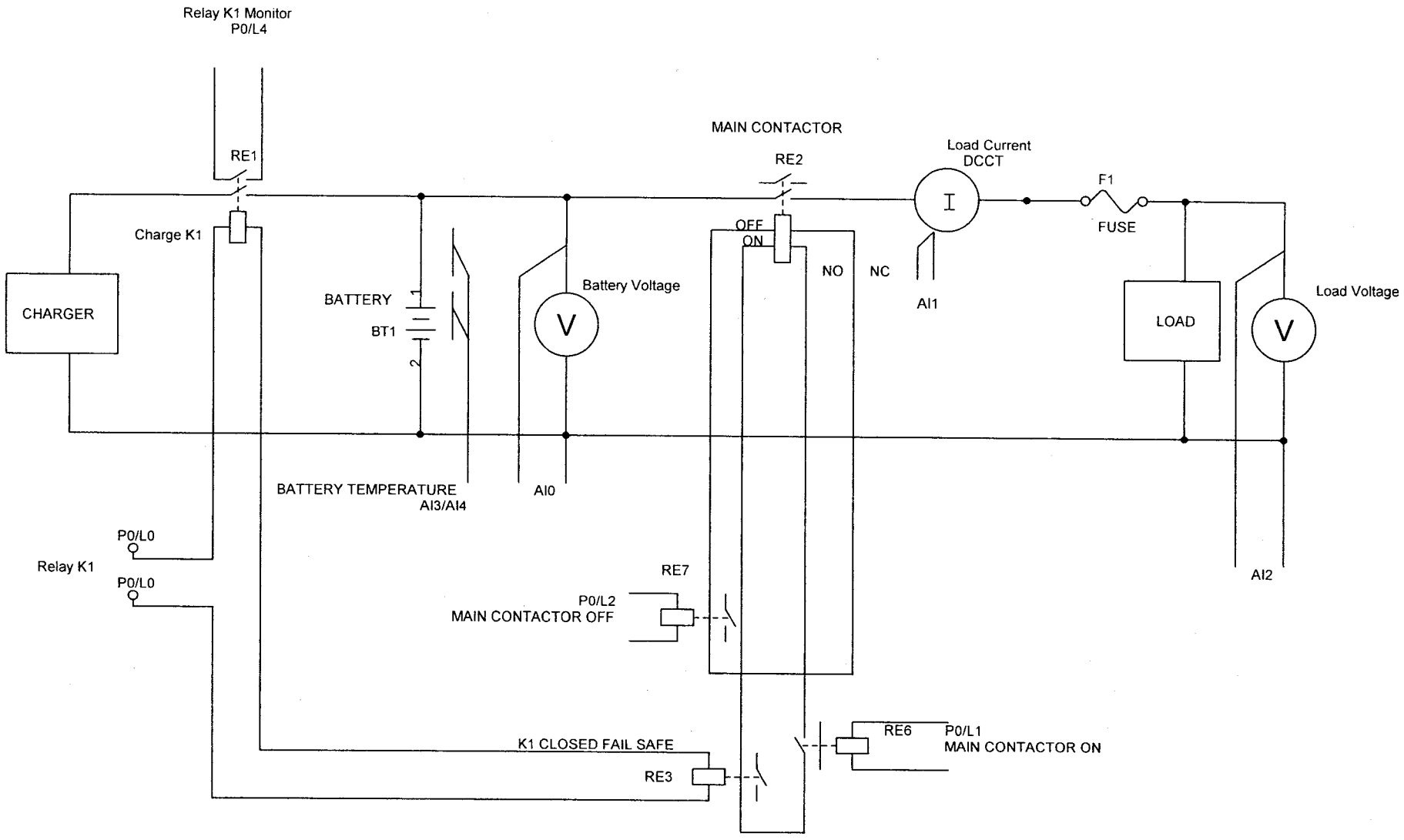
We had a safety review meeting to discuss the safety aspects of this test.
The following people were present in the meeting.
Jon Sandberg, Joseph Glenn, Harold Kirk, P.K. Feng, Ioannis Marneris

A hydrogen calculation was done by Harold Kirk.
We wish to keep the concentration of hydrogen to less than 4% by volume. The rate of hydrogen release is determined by 1 amp x 1 hour x 1 cell => 0.016 cubic feet. For our battery we have 6 cells and a 20 A battery charger, then we can generate (in the worst case mode of full electrolysis) 6x20x0.016 = 1.9 cubic feet of hydrogen per hour or for a 24 hour period 46 cubic feet of hydrogen. We estimate the building room volume to be 30 x 60 x 18 or 32400 cubic feet. At worst we will get a concentration in the building of 0.14 % in one day of full charging with electrolysis.

It was decided to implement the following.

1. During the first phase of testing we should use a resistive load of 14.4 mohms, @700A, 30s, 7.056KW, 212KJ. Thus the maximum current should not exceed 700 amps dc. The current pulse width should not exceed 300 to 400 msec.
2. The resistive load should be roped for safety reasons.
3. We should inspect the trench under the battery cabinet and use a secondary containment around the battery metallic box.
4. A fan should be installed on top of the battery cabinet for better air circulation. Fan should come on if the battery charger is on.

5. The electrical contactor should be enclosed in a metal box easily accessible to inspect the contacts after the first phase of testing.
6. 4/O Cable should be used for all connections between the contactor the battery and the load. A calculation will be done to evaluate the temperature rise of the cable if we pulse it at 700 amps dc with a pulse width 300msec up to 30 sec. A calculation will also be done to evaluate the temperature rise of the cable if we pulse it at 1400 amps dc with a pulse width 300msec up to 30 sec.
7. The temperature of the battery and the load should be monitored.
8. We will try to find a time delay fuse and installed in series with the load rated to protect the 4/O cable.
9. After a few pulses at 700 amps the contact of the contactor should be inspected.
10. The results of the first phase testing should be discussed before proceeding to the next phase, which is at 1050 amps.



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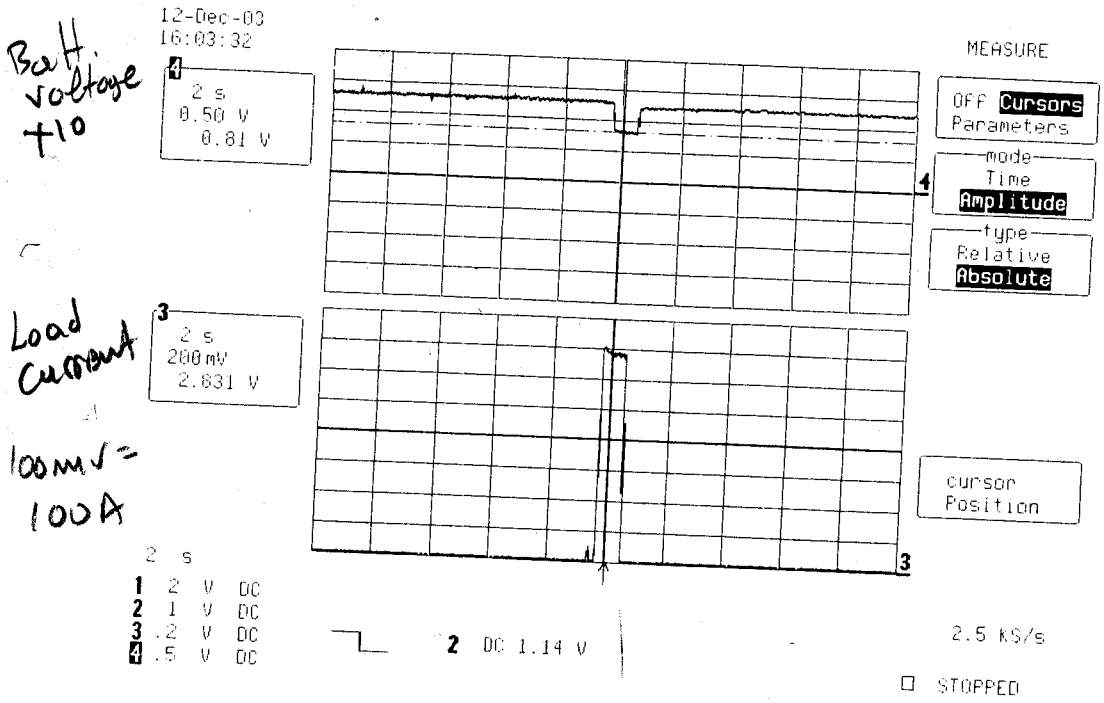
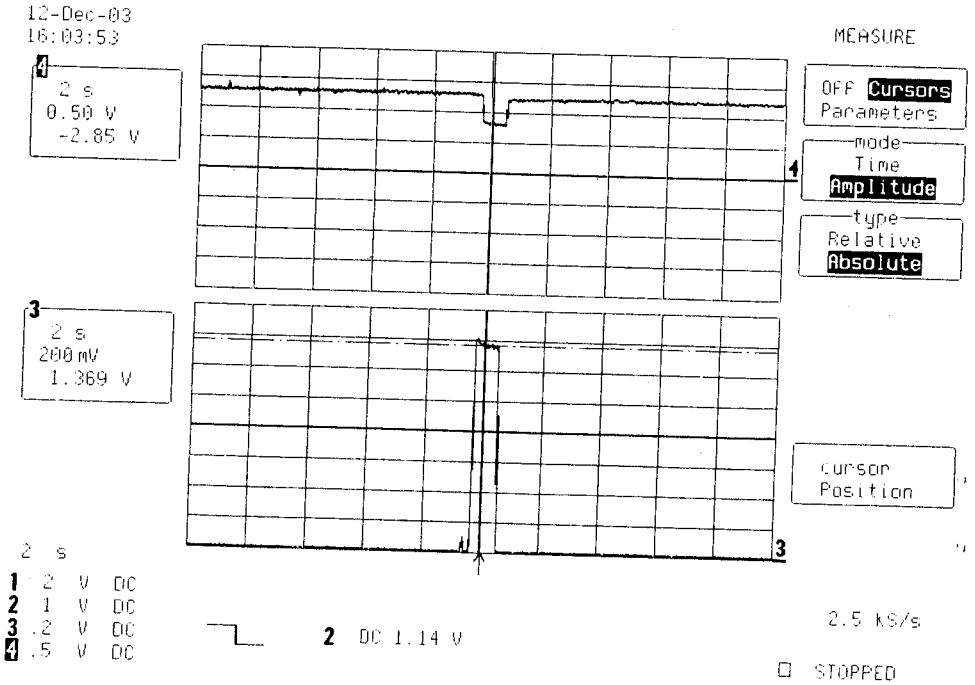
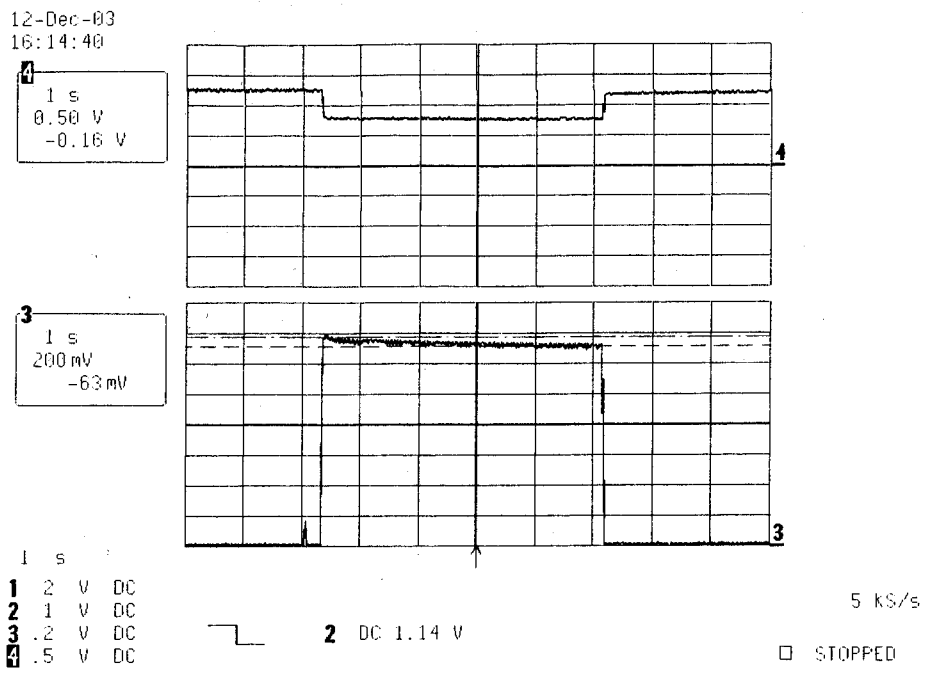
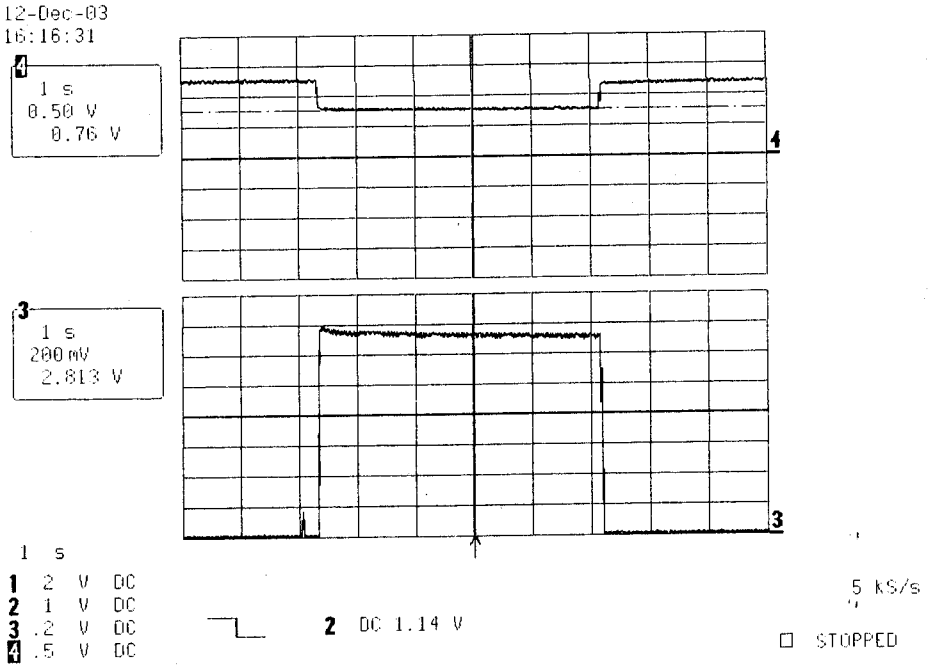
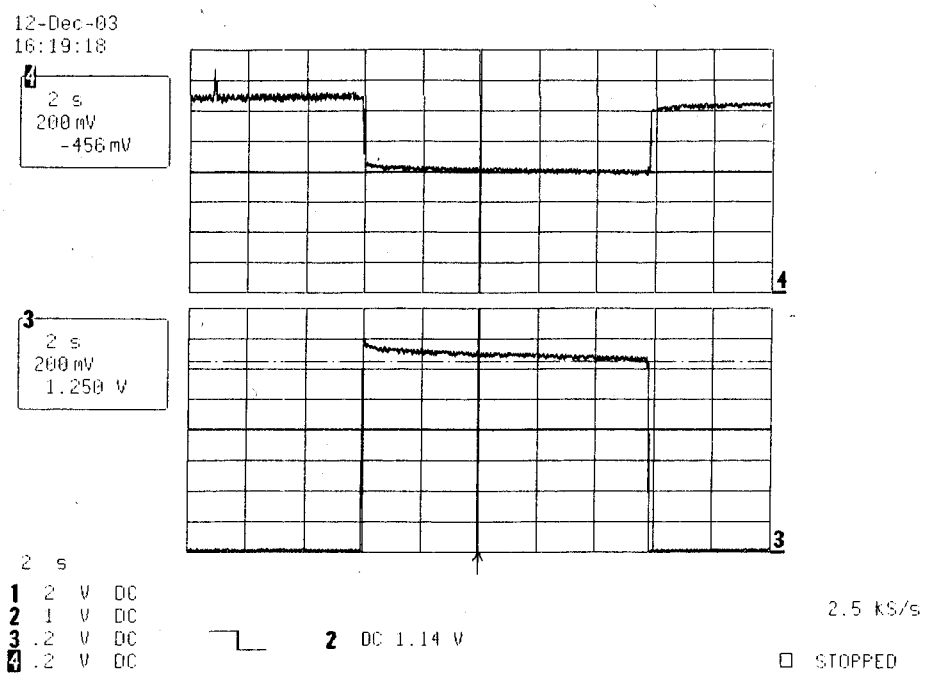
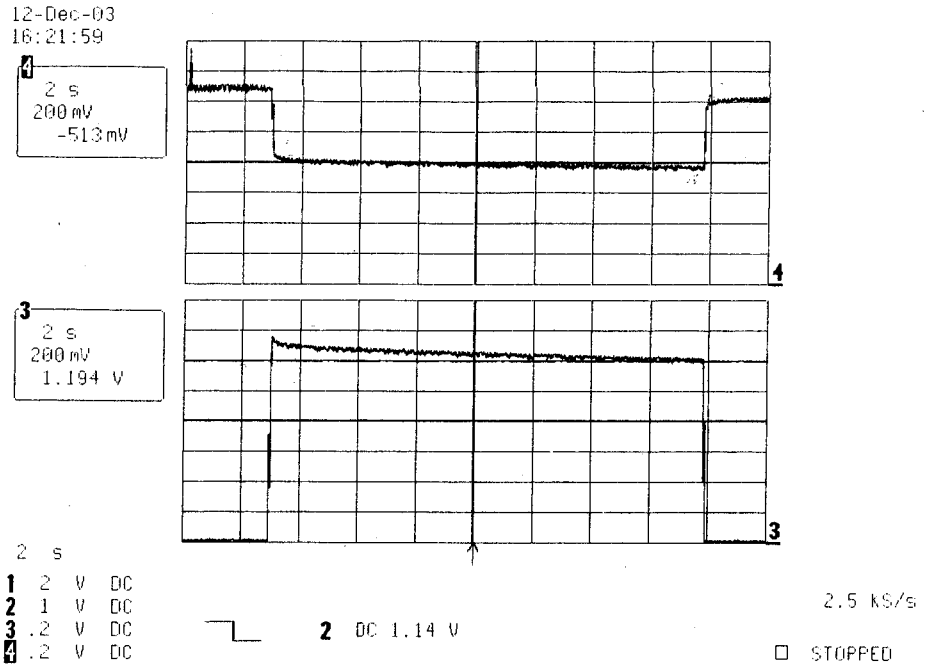

Batt. voltage ÷10
12-Dec-03
16:03:32
4
2 s
0.50 V
0.81 V
MEASURE
OFF Cursors
Parameters
mode
Time
Amplitude
type
Relative
Absolute
Load Current
100mV = 100A
3
2 s
200 mV
2.831 V
cursor
Position
2 s
1 2 V DC
2 1 V DC
3 .2 V DC
4 .5 V DC
2 DC 1.14 V
2.5 kS/s
STOPPED

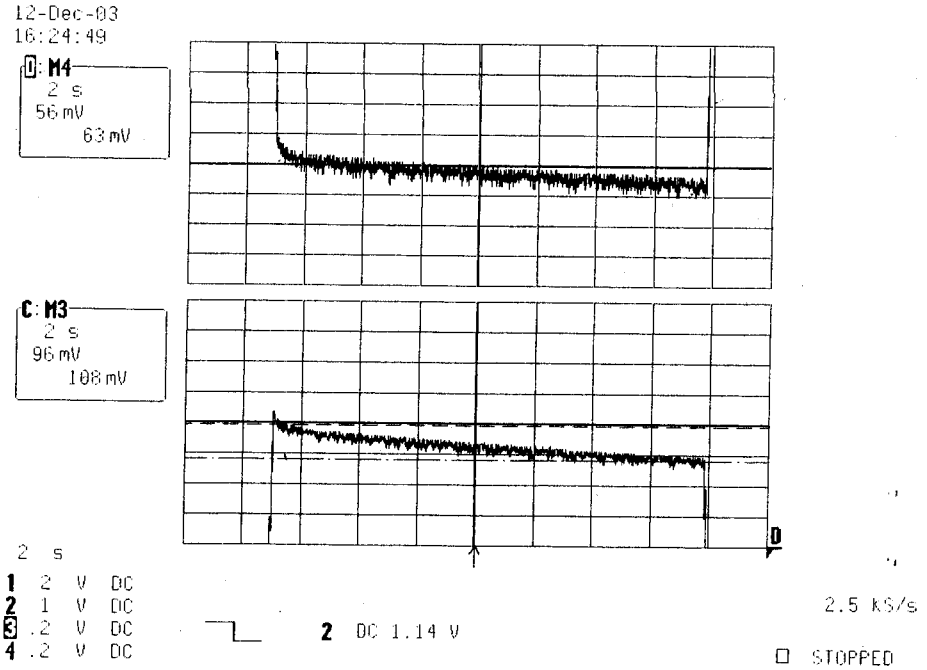

12-Dec-03
16:03:53
4
2 s
0.50 V
-2.85 V
MEASURE
OFF Cursors
Parameters
mode
Time
Amplitude
type
Relative
Absolute
3
2 s
200 mV
1.369 V
cursor
Position
2 s
1 2 V DC
2 1 V DC
3 .2 V DC
4 .5 V DC
2 DC 1.14 V
2.5 kS/s
STOPPED


12-Dec-03
16:14:40
4
1 s
0.50 V
-0.16 V
3
1 s
200 mV
-63 mV
1 s
1 2 V DC
2 1 V DC
3 .2 V DC
4 .5 V DC
2 DC 1.14 V
5 kS/s
STOPPED

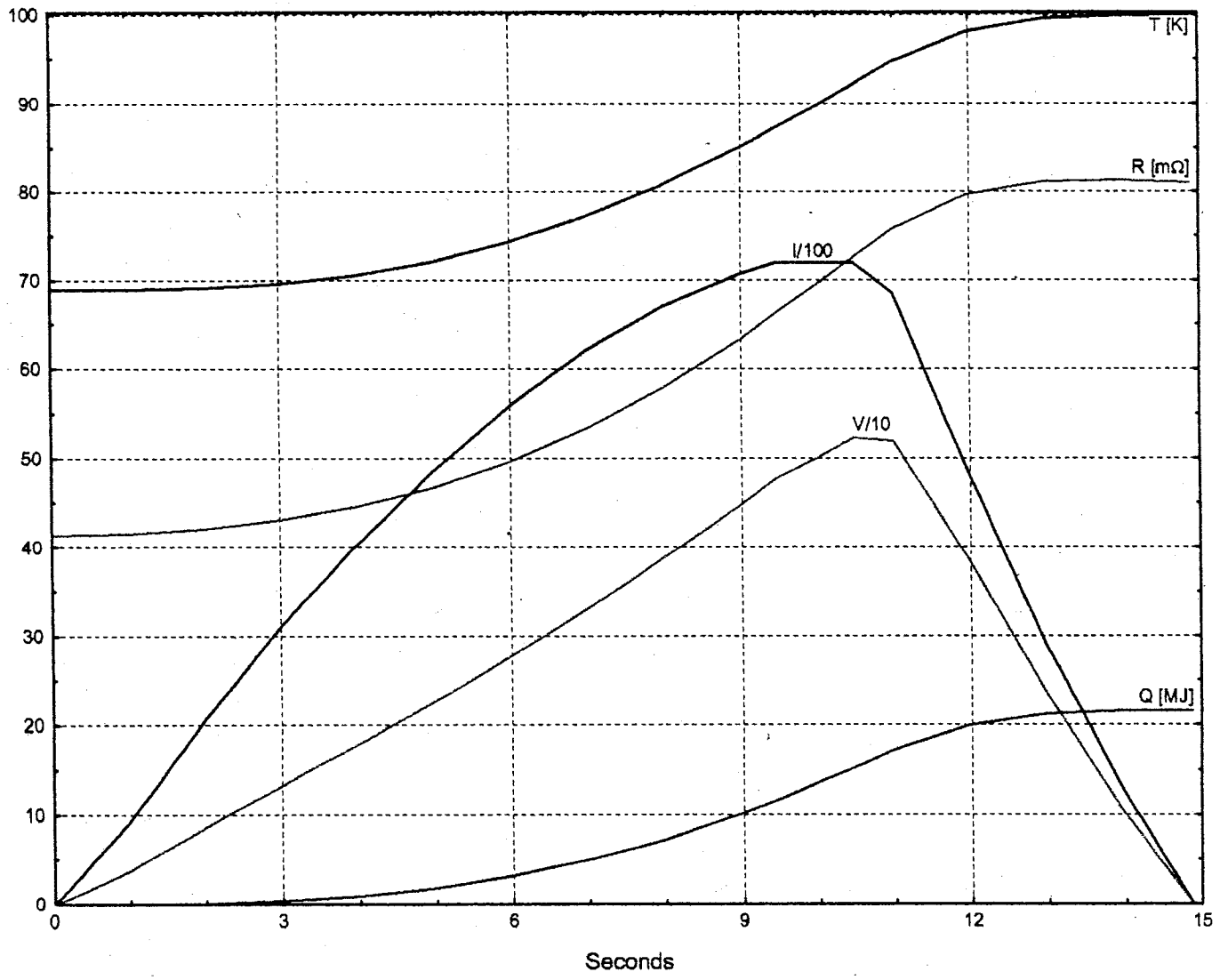

12-Dec-03
16:16:31
4
1 s
0.50 V
0.76 V
3
1 s
200 mV
2.813 V
1 s
1 2 V DC
2 1 V DC
3 .2 V DC
4 .5 V DC
2 DC 1.14 V
5 kS/s
STOPPED


12-Dec-03
16:19:18
4
2 s
200 mV
-456 mV
3
2 s
200 mV
1.250 V
2 s
1 2 V DC
2 1 V DC
3 .2 V DC
4 .2 V DC
2 DC 1.14 V
2.5 kS/s
STOPPED


12-Dec-03
16:21:59
4
2 s
200 mV
-513 mV
3
2 s
200 mV
1.194 V
4
3
2 s
1 2 V DC
2 1 V DC
3 .2 V DC
4 .2 V DC
2 DC 1.14 V
2.5 kS/s
STOPPED


12-Dec-03
16:24:49
M4
2 s
56 mV
63 mV
C: M3
2 s
96 mV
108 mV
0
2 s
1 2 V DC
2 1 V DC
3 .2 V DC
4 .2 V DC
2 DC 1.14 V
2.5 kS/s
STOPPED

Parameters of Pulse Coil Precooled to 69 K and Energized at 600 V to 7200 A



Bob Weggel's 10-14 analysis of the LN2 magnet operation

$L = 0.4$ to 0.45 H

R see above